

Claims

[c1] What is claimed is:

1. A control unit assembly comprising:
 - a housing;
 - at least one processor to control operation of an engine;
 - a voltage regulator configured to regulate a voltage of at least one rail of the engine; and
 - wherein the at least one processing unit and the voltage regulator reside on a common circuit board.

[c2] 2. The assembly of claim 1 further comprising a common housing enclosing the at least one processor and the voltage regulator.

[c3] 3. The assembly of claim 1 wherein the at least one processor is configured to control operation of at least one of an ignition system, a fuel injection system, an oil drive system, a cooling system, a diagnostic system, a shift control system, an exhaust valve drive system, a water injection system, an alternator charging system, a battery charge system.

[c4] 4. The assembly of claim 1 wherein the voltage regulator includes a buck converter configured to receive a voltage

of a first rail of the engine and supply a charging voltage to a second rail of the engine.

- [c5] 5. The assembly of claim 4 wherein the voltage of the first rail is optimally 55 volts DC and the voltage of the second rail is optimally 12–14 volts DC.
- [c6] 6. The assembly of claim 1 further comprising a heat sink mounted to the common circuit board and having power components of the at least one processor and the voltage regulator in thermal communication therewith.
- [c7] 7. The assembly of claim 6 wherein the heat sink is a one-piece extrusion.
- [c8] 8. The assembly of claim 6 wherein the heat sink is secured to the common circuit board transverse to a longitudinal length of the common circuit board.
- [c9] 9. The assembly of claim 6 wherein the at least one processor on one side of the heat sink and the voltage regulator is on another side of the heat sink.
- [c10] 10. The assembly of claim 6 further comprising a spring clip retaining the power components to the heat sink.
- [c11] 11. The assembly of claim 1 wherein the control unit is incorporated into a recreational product.

- [c12] 12. The assembly of claim 11 wherein the recreational product is an outboard motor.
- [c13] 13. An engine management module (EMM) comprising:
 - an engine control unit (ECU) mounted on a circuit board and configured to control a plurality of systems of a recreational product engine; and
 - a voltage regulator mounted on the circuit board and configured to regulate a voltage supplied to at least a number of the plurality of systems of the recreational product engine.
- [c14] 14. The EMM of claim 13 further comprising an EMM housing enclosing the ECU and voltage regulator and wherein the circuit board is secured within the housing.
- [c15] 15. The EMM of claim 14 further comprising a heat sink fastened to the circuit board and wherein the heat sink includes an inlet and an outlet constructed to be connected to a cooling source such that during operation of the recreational product a cooling flow is generated through the EMM housing.
- [c16] 16. The EMM of claim 13 wherein the ECU is configured to control at least an ignition system, a fuel injection system, an oil drive system, a diagnostic system, and a battery charging system.

- [c17] 17. The EMM of claim 13 wherein the voltage regulator includes a DC to DC converter and a switching regulator.
- [c18] 18. The EMM of claim 17 wherein the DC to DC converter includes a buck converter.
- [c19] 19. The EMM of claim 13 wherein the recreational product is one of an outboard motor, a watercraft, an all-terrain vehicle, a motorcycle, a scooter, a snowmobile, and lawn equipment.
- [c20] 20. An outboard motor comprising:
 - a powerhead having a combustion engine, a midsection configured for mounting the outboard motor to a watercraft, and a lower unit powered by the combustion engine to propel a watercraft; and
 - an EMM assembly including:
 - a circuit board;
 - at least one processor attached to the circuit board and programmed to control engine operation; and
 - at least one voltage regulator attached to the circuit board and arranged to regulate rail voltage of the engine.
- [c21] 21. The outboard motor of claim 20 wherein the at least one voltage regulator includes a buck converter configured to deliver a charging power to a battery system and

the at least one processor has a plurality of control maps.

- [c22] 22. The outboard motor of claim 21 further comprising a heat sink mounted to the circuit board and configured to simultaneously cool at least a portion of the at least one processor and the at least one voltage regulator.
- [c23] 23. The outboard motor of claim 20 further comprising a housing constructed to enclose the circuit board, the at least one processor, and the at least one voltage regulator.
- [c24] 24. The outboard motor of claim 23 further comprising a plurality of connections extending through the housing and constructed to provide electrical connections from the at least one processor and at least one voltage regulator through the circuit board to an exterior of the housing.